

I hereby certify that this correspondence (including Exhibits) is being deposited with the United States Postal Service via Express Mail in an envelope addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on August 15, 2006 (Express Mail Label No.: ET615079096US).



  
Nattu J. Patel

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of C. Earl Woolfork

Serial No. 10/648,012

Group Art Unit: 2615

Confirm. No.: 3337

Examiner: Andrew C. Flanders

Filed: August 26, 2003

For: WIRELESS DIGITAL AUDIO MUSIC SYSTEM

**DECLARATION OF APPLICANT UNDER 35 USC Section 132**

I, C. Earl Woolfork, being duly sworn, depose and declare as follows:

1. I am the Inventor of the above referenced patent application ("Application"). I have personal knowledge of the following matter and if asked to testify, could and would testify competently, thereto.

2. Daphne Burton, my then attorney, conducted the interview with Examiner Flanders and Supervisory Patent Examiner Tran (collectively "Examiners") on June 13, 2006 regarding the pending office action dated May 17, 2006 ("Office Action"). I participated in that interview.

3. During the interview, among other things, page 6 of the Office Action was discussed, which states that, "A frequency shift keying (FSK) modulation/detection technique could be used given a frequency hopping spread spectrum (FHSS) system choice. The terms and techniques discussed in this sentence (FSK and FHSS) were not present in the parent disclosure nor in the current application's disclosure and thus are new matter."

4. During the interview, I explained to the Examiners that that FSK is an inherent feature of FHSS and that FHSS and direct sequence spread spectrum ("DSSS") are two inherent features of CDMA. In response to the discussion, Examiners requested that I submit evidence through an affidavit under 35 USC Section 132 providing substantiation.

5. I am hereby submitting this affidavit together with the supporting documentation for consideration and respectfully requesting that the new matter rejection relating to this particular issue be withdrawn.

6. Paragraph 0016, lines 14 – 16 of the Parent Application 10/027,391, recites in part that, "This code division multiple access technique (CDMA) may be used to provide each user independent operation."

7. Relevant pages from the well known text book entitled, "Spread Spectrum Systems with Commercial Applications," by Robert C. Dixon, Third Edition, are attached herewith as Exhibit A. Here are the relevant excerpts from Exhibit A:

a. "CDMA, or code-division multiple access systems, use codes to separate one signal from another . . . . Either direct sequence or frequency hopping systems can employ CDMA,..." (Refer to Page 2 of Exhibit A)

b. "For some reason which is not obvious, it is often assumed that CDMA and direct sequence methods are synonymous. Our discussion of CDMA in the previous section certainly applies to direct sequence (notice that the words "direct sequence" were never used) but also may be applied to frequency hopping." (Refer to Page 3 of Exhibit A)

c. "Frequency hopping modulation is more accurately termed multiple frequency, code selected, frequency shift keying. It is nothing more than FSK (frequency shift keying) except that the set of frequency choices is greatly expanded." (Refer to Page 4 of Exhibit A).

8. Based the above, it is apparent to one skilled in the art that FSK is an inherent feature of FHSS, and FHSS is one of the two inherent features of CDMA (the other inherent feature is DSSS).

Date: 8/14/2010

Respectfully Submitted,

By:  C. Earl Woolfork

EXHIBIT A

SPRINT  
NETWORK  
SYSTEMS

THE

COMMERCIAL APPLICATIONS

THIRD EDITION

ROBERT C. BIRCH

very significant property of TDMA is that users can operate together in a TDMA mode with no near-far problem at all.

Transmission of single-user-per-carrier TDMA is also a practical technique, and is the basis for "digital cellular" systems. In such systems, much of the overhead required is not taken up by actual transmission of data; however, instead, to prevent signals that are transmitted by multiple users at varying distances from a receiver, from arriving at the same time, a guard space is added to each time slot.

In small cells, guard time may be insignificant, but in large cells, guard time may actually take up more time than is allowed for data transmission. Since radio signals propagate at approximately six microseconds per mile, any distance uncertainty in the position of a transmitter with respect to a receiver must appear in the guard time allowance in every time slot. Time slot size and guard time are both very important, as larger time slots mean fewer guard times, but processing delay may be longer.

With the 197.9 users we previously postulated, let us consider an example:

- Suppose each 8-Kbps user has 100 time slots per second. He must transmit his data in 80-bit increments, with eight bits of overhead.
- There are 19,790 time slots per second available, each with period 50.5305 microseconds.
- Data is transmitted in 88-bit chunks, at a rate of 1.751820 megabits per second. Thus 46 microseconds per time slot is left for guard time, and this in turn allows approximately a 0.75-mile range uncertainty.
- If longer time slots are used, with fewer per user, longer guard time and therefore larger cells could be accommodated.

This example is intended merely to show the relationships involved in TDMA systems (single user per carrier).

#### Code-Division Multiple Access



CDMA, or code-division multiple access systems, use codes to separate one signal from another (as we have previously discussed in Chapter 11). Either direct sequence or frequency hopping systems can employ CDMA, so we will compare both methods to FDMA and TDMA approaches.

CDMA systems are dependent on the design of codes that are "orthogonal" to one another, at least within the set of codes employed in a network. Orthogonality in this context means simply that all of the codes used must have low enough mutual cross-correlation that they do not significantly interfere with one another over the dynamic range of the signals presented to any receiver in a CDMA network. This is the purpose of the Gold codes, Kasami codes, and Bent codes discussed in Chapter 3. Unfortunately, there is no known set of codes that is completely orthogonal when used in the

conditions\*. But even in a access system with a large  $n$  under these conditions is the why of additive white Gaussian noise to add to more interference power level. If the codes use same time, then the limit on because a receiver will work signals does not exceed the jamming margin. Therefore, if all users' signals are equal jamming margin is a direct

RF band  
data is

In a 1-MHz bandwidth, and mainly

$$1 \times 10^6 \text{ Hz} / 8 \text{ Kbps}$$

and the maximum number codes, each of which means 126.

Improvements might be processing gain reducing to losses.

In frequency hopping, the receiver's jamming margin, frequencies interfered with.

In the ISM bands, of 1 900-MHz band, and 75 frequencies 20% of these frequencies number of users possible we

$$50/5 = 1$$

\*More than 100000 users can exist in a 1-MHz band, etc.

This is an extremely optimistic estimate of system performance, and this is based on 1/2 or 4 Kbps. With the same 10 TDMA users would be up to 100000 users. CDMA would be a much better choice for a system of this type.

If we compare time division CDMA to power-control CDMA, in multiuser networks (for example, a network with a single base station and many randomly distributed users scattered around it), it is easy to see that:

- The time division base station requires only one transmitter and one receiver to service all its associated users. (This includes any signal processing that is to be done.) The power-control base station, on the other hand, requires a separate transmit channel\* and a separate receive channel for every user. This means that a power-control system with 32 users would require 32 transmit channels and 32 receive channels, while the time division system requires only one.

If more users are accommodated, by either reducing data rates or by reducing a base station's coverage, then the number of transmitters and receivers simply goes up by the same amount as the increase in users. Increasing processing gain and thereby jamming margin/number of users, by reducing data rate would allow:

Data Rate	Jamming Margin	Number of Users
8 Kbps	15.9 dB	39.25
4 Kbps	18.9 dB	98.5
2 Kbps	21.9 dB	157

From this we see the value of reducing the data rate in a spread spectrum system. We note, however, that reducing the data rate in non-spread-spectrum systems can produce similar results. (We will see an example of this in the succeeding pages.)

#### Important Note:

It is of no use whatsoever to consider the number of users possible in a spread spectrum system to be 50, 100, or any other number unless the codes employed (remember that we are discussing code division multiple access) are capable of providing sufficiently low cross-correlation between every user and every other user.

#### Frequency Hopping and CDMA

*For some reason which is not obvious, it is often assumed that CDMA and direct sequence methods are synonymous. Our discussion of CDMA in the previous section certainly applies to direct sequence. Indeed, that the words "direct sequence" were never used but also may be applied to frequency hopping.*

\*A single power amplifier and a single receiver are not *per se* as can be used, but separate processing, modulation and demodulation is still needed for every user because each user is spreading each modulation independently from every other user.

If one has two or more bandwidths, but using different codes called code division multiple access, no matter how many users, only direct sequence with frequency hopping is a function of the rate that we have a 1.25-MHz RF rate 1/2 ending 119.2-K symmetrical. We will also use 1/2. CDMA is MSK modulation.

Bandwidth per channel

Number of channels available

Jamming MARGIN (dB)

(S/N)

Jamming Margin (other way)

(This assumes five channels of jammed channel produces a)

In military systems, it is respect to every other user, many channels available and link each user with respect sequentially uses the same randomly interfere with one support up to 832 users to be

Commercial users are a huge number of channels or to enable that offering of code sequence to every channel in the approach is effectively the same channel being used, therefore greatly increased.

## 2.2 SPREAD SPECTRUM TECHNIQUES

some advantages that other forms of direct sequence modulation cannot match. We hasten to state that there are many forms of MSK modulation, each with different spectrum and characteristics. Offset QPSK is, in fact, one form of MSK modulation. We will further discuss these forms and compare their characteristics in detail in Chapter 4.

### 2.2.1 FREQUENCY HOPPING\*

\* "Frequency hopping" modulation is more accurately termed "multiple-frequency, unselected, frequency shift keying." It is nothing more than FSK (frequency shift keying) except that the set of frequency choices is greatly expanded. Simple FSK most often uses only two frequencies, for example,  $f_1$  to signify a "mark,"  $f_2$  to signify a "space." Frequency hoppers, on the other hand, often have thousands of frequencies available. One real system<sup>11</sup> has  $2^{20}$  discrete frequency choices, randomly chosen, each selected on the basis of a code in combination with the information transmitted. The number of frequency choices and the rate of hopping from frequency to frequency in any frequency hopper is governed by the requirements placed on it for a particular use.

#### Characteristics of Frequency Hopping Signals

A frequency hopping system or "frequency hopper" consists basically of a code generator and a frequency synthesizer capable of responding to the coded output from the code generator. A great deal of effort has been expended in developing rapid-response frequency synthesizers for spread spectrum systems.

Ideally, the instantaneous frequency hopper output is a single frequency. Practically, however, the system user must be satisfied with an output spectrum which is a composite of the desired frequencies, sidebands generated by hopping, and spurious frequencies generated as by products.

Figure 2.12 is a simplified block diagram of a frequency hopping transmission system. The frequency spectrum of this frequency hopper is shown in Figure 2.13.

Over a period of time, the ideal frequency hopping spectrum would be perfectly rectangular, with transmissions distributed evenly in every available frequency channel. The transmitter should also be designed to transmit to a degree as close as practical, the same amount of power in every channel.

The received frequency hopping signal is mixed with a locally generated replica, which is offset a fixed amount such that  $(f_1, f_2, \dots, f_n) \times (f_1 + f_m, f_2 + f_m, \dots, f_n + f_m)$  produces a constant difference frequency  $f_m$  when transmitter and receiver code sequences are in synchronism.

\*See the Bibliography, Sections 4, 7, and 8.

